IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant	: Arnold P. Kehrli	Art Unit	: 2836
Serial No.	: 10/658,597	Examiner	: Dru M. Parries
Filed	: September 9, 2003	Conf. No.	: 1923
Title	: LOW IMPEDANCE TRANSMISSION LINE WITH A POWER FLOW CONTROLLER		

MAIL STOP APPEAL BRIEF-PATENTS
Commissioner for Patents
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BRIEF ON APPEAL

(1) Real Party in Interest

The real party in interest in the above application is American Superconductor Corporation.

(2) Related Appeals and Interferences

The Appellant is not aware of any appeals or interferences related to the above-identified patent application.

(3) Status of Claims

This is an appeal from the decision of the Examiner in an Office Action dated June 10, 2008, rejecting claims 1, 3-11, and 13-22; and an Advisory Action dated August 7, 2008, rejecting claims 1, 3-11, 13-15, and 19-23. The claims of the invention have been twice rejected.

Claims 1, 3-11, and 13-15, and 19-23 are pending in this application and are the subject of this appeal.

(4) Status of Amendments

Appellant last amended the claims in response to the final Office Action of June 10, 2008. All amendments have been entered. The pending claims are found below as a Claims Appendix.

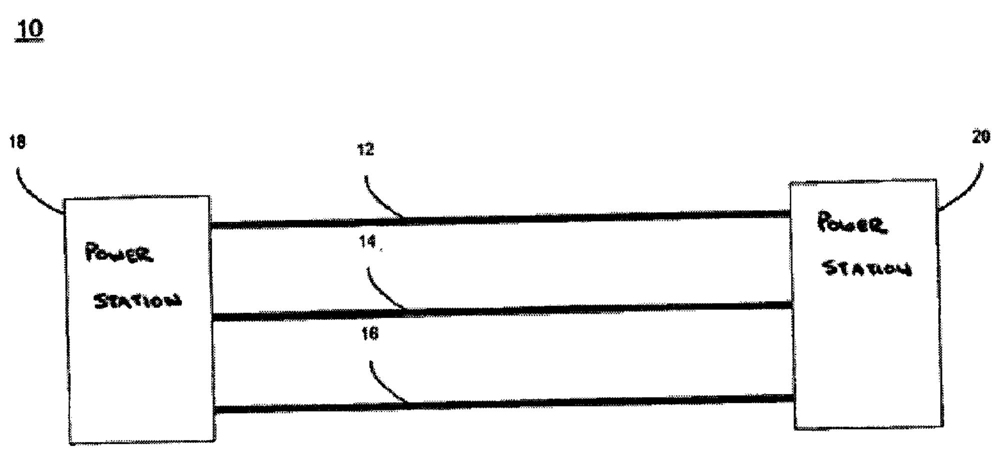
Appellant filed a Notice of Appeal on September 4, 2008.

(5) Summary of Claimed Subject Matter

This invention relates to a low impedance transmission line with a power flow controller. Transmission lines are used to transfer electrical power from one point in a utility network to another. Transmission lines have associated electrical impedance, which is typically expressed in ohms. The higher the impedance of the transmission line, the greater the amount of real and reactive power dissipated along the length of the line. Therefore, as the impedance of the transmission line decreases, both the efficiency of the transmission line and the ability to transfer energy increase (p. 1, lines 9-12).

Appellant's invention relates to a multi-line utility power transmission system comprising a first power transmission line having a first impedance characteristic and a second power transmission line including a superconductor, in parallel with the first power transmission line, and having a second impedance characteristic less than the first impedance characteristic, as recited in independent claims 1 and 23.

Fig. 1, reproduced below, shows a power transmission system 10 having multiple power transmission lines 12, 14, and 16 connected in parallel. Each power transmission line has an impedance value. When power is transmitted through power transmission system 10, "the flow of power is divided among the three lines, such that the level of power flowing through each line is inversely proportional to its impedance" (p. 4, lines 11-12). That is, for two power transmission lines connected in parallel, the power



transmission line having the lower impedance will carry more power than the power transmission line having the higher impedance. A superconducting transmission line in its superconducting state has a significantly lower impedance than a conventional power transmission line (p. 6, lines 1-6). Thus, a superconducting transmission line connected in parallel with a conventional power transmission line will carry significantly more power than the conventional transmission line. For instance, if two conventional power transmission lines having impedance values of 2 ohms and 4 ohms and one superconducting power transmission line having an impedance value of 0.1 ohms are connected in parallel, the superconducting power transmission line will carry 93.025% of the power flowing through the multi-line power transmission system (p. 6, lines 21-25; p. 7, lines 8-11).

Appellant's multi-line utility power transmission system includes a power flow controller, coupled to the second power transmission line, for selectively regulating during normal operating conditions of the power transmission system by a variable amount at least one of the magnitude and direction of the power flowing through the second power transmission line. The use of a power flow controller allows the amount of current that is allowed to pass through the superconducting transmission line to be restricted and/or regulated in order to "control the impedance of the phase angle (and, therefore, real power) through the superconducting transmission line" (p. 7, lines 3-7). This arrangement is useful for reasons including load balancing, contractual arrangements, or flow optimization (p. 7, lines 2-5). By using a power flow controller, the amount of power flowing through each parallel transmission line can be regulated. For instance, in the example given above, the amount of power flowing through the superconducting transmission line can be reduced to less than 93.025% of the total power through use of a power flow controller. Alternatively, the direction of the power flowing through the superconducting power transmission line can be changed (p. 7, lines 19-22).

(6) Grounds of Rejection to be Reviewed on Appeal

Claims 1, 3-11, 13-15, and 19-23 stand rejected under 35 U.S.C. 103(a) as being unpatentable over U.S. Patent Publication No. 2003/0183410 to Sinha et al. (hereinafter Sinha) in view of U.S. Patent 6,344,956 to Morita et al. (hereinafter Morita).

(7) Argument

The Law – Obviousness

To establish a prima facie case of obviousness, three basic criteria must be met. First, there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or to combine reference teachings. Second, there must be a reasonable expectation of success. Finally, the prior art reference (or references when combined) must teach or suggest all the claim limitations. (MPEP 2143)

All claim elements must be taught or suggested by the prior art. All words in a claim must be considered in judging the patentability of that claim against the prior art. ***In re Wilson***, 424 F.2d 1382, 1385, 165 USPQ 494, 496 (CCPA 1970). If an independent claim is nonobvious under 35 U.S.C. 103, then any claim depending therefrom is nonobvious. ***In re Fine***, 837 F.2d 1071, 5 USPQ2d 1596 (Fed. Cir. 1988)

Obviousness can be established by combining or modifying the teachings of the prior art to produce the claimed invention where there is some teaching, suggestion, or motivation to do so. ***In re Kahn***, 441 F.3d 977, 986, 78 USPQ2d 1329, 1335 (Fed. Cir. 2006). "Rejections on obviousness cannot be sustained by mere conclusory statements; instead, there must be some articulated reasoning with some rational underpinning to support the legal conclusion of obviousness." ***KSR International Co. v. Teleflex Inc.***, 550 U.S. at ___, 82 USPQ2d, 1385, 1396 quoting ***In re Kahn***, 441 F.3d 977, 988, 78 USPQ2d 1329, 1336 (Fed. Cir. 2006). Although KSR rejected a rigid application of the teaching, suggestion or motivation test in an obviousness inquiry, the Federal Circuit noted that the Supreme Court still "acknowledged the importance of identifying 'a reason that would have prompted a person of ordinary skill in the relevant field to combine the elements in a way the claimed new invention does' in an obviousness determination." Id. at 1356-1357. ***P&G v. Teva Pharms. USA, Inc.***, 536 F. Supp. 2d 476 (US Dist 2008).

It is impermissible to use the claims as a frame, and the references as a mosaic, to pick and choose selected pieces, out of context, to reconstruct the invention. ***Northern Telecom v. Datapoint***, 908 F.2d 931 (CAFC 1990). In order to combine references, the Examiner must show some motivation, suggestion, or teaching of the desirability of making the combination. ***In re Dembiczak***, 50 USPQ 2d 1614, 1617 (CAFC 1999). It is well established that there must be some logical reason apparent from the evidence or record to justify combination or modification of references. ***In re Regal***, 526 F.2d 1399 188, U.S.P.Q.2d 136 (C.C.P.A. 1975).

Even if all of the elements of claims are disclosed in various prior art references, the claimed invention taken as a whole cannot be said to be obvious without some reason given in the prior art why one of ordinary skill in the art would have been prompted to combine the teachings of the references to arrive at the claimed invention. ***In re Regal***, 526 F.2d 1399 188, U.S.P.Q.2d 136 (C.C.P.A. 1975). Even if the cited references show the various elements suggested by the Examiner in order to support a conclusion that it would have been obvious to combine the cited references, the references must either expressly or impliedly suggest the claimed combination or the Examiner must present a convincing line of reasoning as to why one skilled in the art would have found the claimed invention obvious in light of the teachings of the references. ***Ex Parte Clapp***, 227 U.S.P.Q.2d 972, 973 (Board. Pat. App. & Inf. 985).

A statement that modifications of the prior art to meet the claimed invention would have been "'<u>well within the ordinary skill of the art</u> at the time the claimed invention was made'" because the references relied upon teach that all aspects of the claimed invention were individually known in the art is not sufficient to establish a *prima facie* case of obviousness without some objective reason to combine the teachings of the references. ***Ex parte Levengood***, 28 USPQ2d 1300 (Bd. Pat. App. & Inter. 1993).

If proposed modification would render the prior art invention being modified unsatisfactory for its intended purpose, then there is no suggestion or motivation to make

the proposed modification. ***In re Gordon***, 733 F.2d 900, 221 USPQ 1125 (Fed. Cir. 1984)

A prior art reference must be considered in its entirety, i.e., as a whole, including portions that would lead away from the claimed invention. ***W.L. Gore & Associates, Inc. v. Garlock, Inc.***, 721 F.2d 1540, 220 USPQ 303 (Fed. Cir. 1983), *cert. denied*, 469 U.S. 851 (1984).

Claim 1

For the purposes of this appeal only, claims 1, 3-9, and 19-22 may be treated as standing or falling together. Claim 1 is representative of this group.

Claim 1 is directed to a multi-line utility power transmission system comprising a first power transmission line having a first impedance characteristics; a second power transmission line including a superconductor, in parallel with the first power transmission line, and having a second impedance characteristic less than the first impedance characteristic; and a power flow controller, coupled to the second power transmission line, for selectively regulating during normal operating conditions of the power transmission system by a variable amount at least one of the magnitude and direction of the power flowing through the second power transmission line. The power flow controller is configured to selectively regulate the power flowing through the second power transmission line to provide at least one of load balancing between the first power transmission line and the second power transmission line and flow optimization between the first power transmission line and the second power transmission line. The power flow controller is also configured to provide incremental flow change of current.

Sinha describes an electric system having a first and a second power transmission line in parallel, the second power transmission line including a superconductor. The Examiner acknowledges that Sinha fails to disclose a power flow controller, but contends that Morita does disclose a power flow controller in the form of a current-limiting element. The Examiner further argues that it would have been obvious to modify Sinha's superconductor transmission line to include Morita's current-limiting element.

As discussed in more detail below, we submit that Morita's current-limiting element is not equivalent to Appellant's power flow controller. Furthermore, even assuming *arguendo* that Morita's current-limiting element was a power flow controller, we submit that it would not have been obvious to one of ordinary skill in the art to combine Morita's current-limiting element with Sinha's electric system.

1. Morita's current-limiting element is not a power flow controller

Morita's current-limiting element provides a non-incremental transition

Appellant's power flow controller "selectively regulat[es] ... by a variable amount at least one of the magnitude and direction of the power" and further "is configured to provide *incremental* flow change of current," as recited in independent claim 1.

In contrast, Morita describes a current-limiting element that "provide[s] a mechanism which promotes or generates quenching ... to accomplish transition of the current-limiting element from a superconductive state to a normal conductive state. ... '[Q]uenching' refers to a sudden transition from superconduction to normal conduction" (Morita col. 2, lines 54-55, 60, and 66-67). Morita's transition from superconductive power flow to normal power flow is non-incremental; rather, it is sudden and induces a significant change in resistance. Such a change in resistance results in a corresponding significant change in the current flowing through any circuit element connected to the current-limiting element:

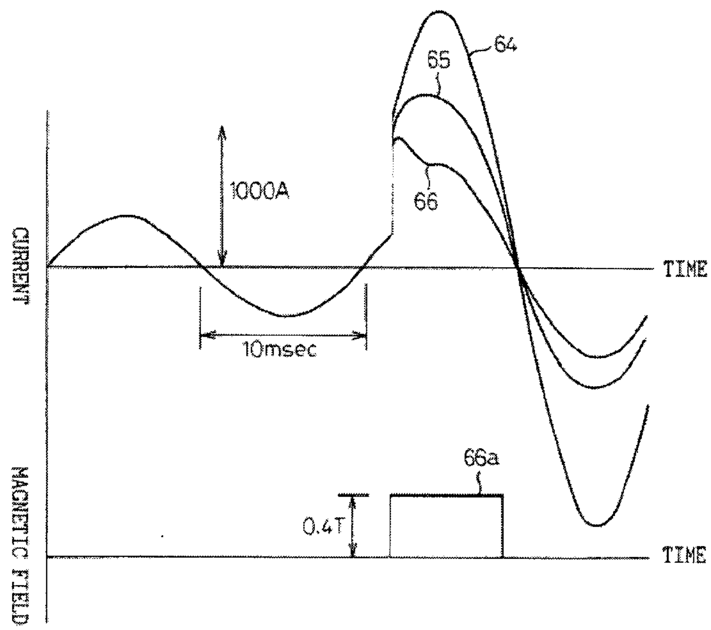
> "In the event of a short-circuit accident, however, the current flowing to the superconductor [through the current-limiting device] exceeds the critical current, and the heat generated thereby causes transition of the superconductor from a superconductive state to a normal conductive state, thus generating electrical resistance. This resistance limits the fault current" (Morita col. 1, lines 50-55).

That is, Morita's current-limiting element ostensibly has only two states of resistance. In a first state of resistance of the current-limiting element, the superconductor is in a superconducting state (under regular operating conditions) and there is virtually no

resistance to power flowing through the device at superconductive levels. In a second state, the resistance of the current-limiting element becomes relatively high due to the presence of a fault current, and the superconductor assumes a normal conductive state rather than a superconducting state. Since power flow is a function of resistance, this sudden transition results in a step-like, non-incremental change in power flow. Furthermore, a discrete and well-defined drop in resistance occurs upon the transition from a superconductive state to a normal conductive state. This drop in resistance results in a similarly well-defined reduction in the flow of power. Morita's current-limiting element is incapable of either providing incremental flow change of current or regulating by a variable amount the power flow.

As shown in Morita's Fig. 10, reproduced below, a fault that occurs in a circuit without a current-limiting element results in conduction of a current 64; the same fault occurring in a similar circuit including a current-limiting element results in conduction of a current 66 (see also col. 8, lines 1-35). Current 66 shows a sudden and significant decrease upon application of a magnetic field 66a (that is, upon quenching of the current-limiting element). Morita's current-limiting element clearly provides a substantial, non-incremental change in current; it is not configured to provide incremental change in current, nor can it regulate the power flow by a variable amount. In fact, because the operation of Morita's current-limiting element is based on a large change in resistance as a result of quenching from superconductivity to normal conductivity, it would not be possible for the current-limiting element to provide *incremental* flow change of current, nor to selectively regulate *by a variable amount* at least one of the magnitude and direction of the power flow.

FIG. 10



Morita's current-limiting element operates under fault conditions

Appellant's power flow controller "selectively regulat[es] *during normal operating conditions* of the power transmission system … at least one of the magnitude and direction of the power flowing through the second power transmission line," as recited in independent claim 1. For instance, the power flow controller can be a reactor, which is a device that "limit[s] the amount of current that can flow on a line (i.e., superconducting transmission line 50) … by adding their own impedance to the line's normal impedance" (p. 7, lines 13-17). That is, Appellant's power flow controller operates while current is flowing on the second power transmission line to regulate the magnitude and/or the direction of the current flowing on that line.

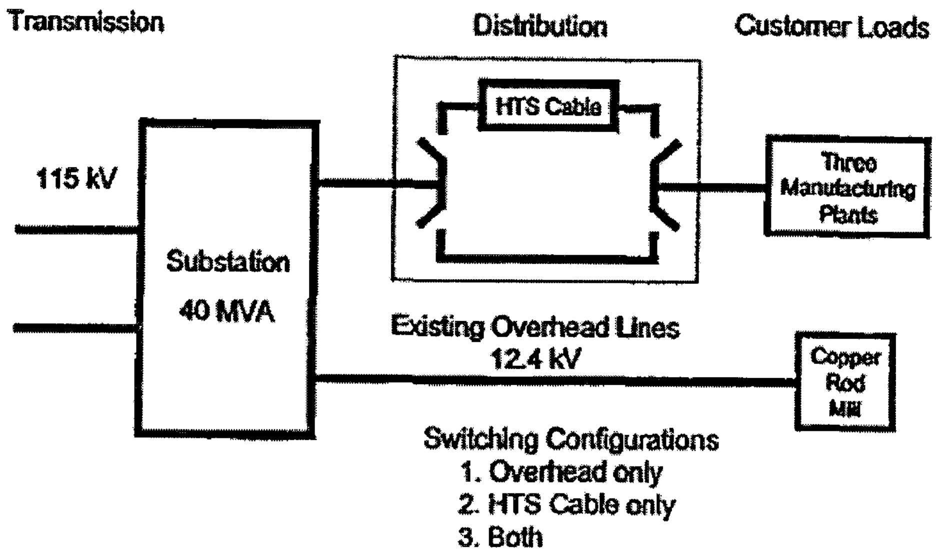
Morita discloses a current-limiting element that operates only upon detection of a fault. That is, Morita's current-limiting element does not play any role during normal operating conditions of the power transmission system. Instead, it operates under fault conditions, "at the point where the current value flowing through the current-limiting element exceeds a given value" (col. 7, lines 39-41). The current-limiting element acts as

a fault current limiter which does not have a function under normal operating conditions and reacts only when a fault condition arises: "[t]he magnetic field must be applied immediately after detection of abnormal current" (col. 5, lines 27-28). Nowhere does Morita describe or suggest that the current-limiting element can selectively regulate *during normal operating conditions* at least one of the magnitude and direction of the power flowing through the second power transmission line.

2. Combining Sinha and Morita is not obvious

Even assuming arguendo that Morita's current-limiting element is a power flow controller (which we deny for at least the above reasons), we submit that there are further reasons why a person of skill in the art would not have found it obvious to couple Morita's current-limiting element to the superconducting cable of Sinha's electric system.

Sinha's electric system, shown in Fig. 29 and reproduced below, depicts a superconducting transmission line and a non-superconducting overhead transmission line connected in parallel between a substation and a load. In such a configuration, the non-superconducting transmission line is provided in parallel to serve as a bypass line in the event that the superconducting transmission line fails or requires maintenance. In such arrangements and in normal operation, maximizing power flow through the superconducting line is generally desirable in order to maximize power transmission between the substation and the load.



We submit that coupling a power flow controller to a second power transmission line including a superconductor (such as Sinha's superconducting transmission line) in parallel with a first power transmission line (such as Sinha's overhead line) is counterintuitive since doing so could decrease the level of power flow through the lower impedance second power transmission line. Applicant was the first to appreciate that in such arrangements, coupling a power flow controller to the second power transmission line including a superconductor has advantages. In particular, without a power flow controller, power would flow primarily through the second power transmission line including a superconductor. Coupling the power flow controller to the second power transmission line would provide for the regulation of power flowing through that line, thus allowing the level of power flow in both the first and the second power transmission lines to be adjusted during normal operating conditions of the power transmission system. That is, a portion of the power could be forced to flow through the higher impedance first transmission line in order to achieve a certain amount of power flow through each power transmission line. Indeed, coupling a power flow controller to the second power transmission line including a superconductor provides "at least one of load balancing … and flow optimization between the first power transmission line and the second power transmission line," as recited in claim 1.

In light of these advantages, we argue that it is not obvious to couple a power flow controller to a second power transmission line including a superconductor, in parallel with a first power transmission line, because such a configuration could be used to reduce the proportion of power flowing through the second power transmission line during normal operating conditions. Thus, even if Morita's current-limiting element was a power flow controller, we submit that it would not have been obvious to couple it to the superconducting cable of Sinha's electric system.

For at least the above reasons, we submit that independent claim 1 is patentable over Sinha and Morita. Since claims 3-9 and 19-22 depend from claim 1, they are patentable for at least the same reasons claim 1 is patentable. We therefore respectfully request that these claims be allowed.

Claim 10

For the purposes of this appeal only, claims 10, 11, and 13-15 may be treated as standing or falling together. Claim 10 is representative of this group.

Claim 10 is directed to a method comprising connecting a first power transmission line having a first impedance characteristic in parallel with a second power transmission line including a superconductor and having a second impedance characteristic less than the first impedance characteristic; supplying power to the first power transmission line and the second power transmission line; determining a level of power flow for the second power transmission line; and selectively regulating during normal operating conditions of the power transmission system by a variable amount the power transferred through the second power transmission line to provide at least one of load balancing between the first power transmission line and the second power transmission line and flow optimization between the first power transmission line and the second power transmission line. Selectively regulating the amount of power transferred through the second power transmission line includes changing the flow of current incrementally.

As discussed above, we submit that Morita's current-limiting element does not "selectively regulat[e] during normal operating conditions … by a variable amount the power transferred through the second power transmission line … wherein selectively regulating … includes changing the flow of current incrementally," as recited in independent claim 10. Furthermore, as discussed above, we submit that even assuming Morita's current-limiting element could perform these steps, it would not have been obvious to one of ordinary skill in the art to couple Morita's current-limiting element with Sinha's electric system to arrive at the method of claim 10.

For at least the above reasons, we submit that independent claim 10 is patentable over Sinha and Morita. Since claims 11 and 13-15 depend from claim 10, they are patentable for at least the same reasons claim 10 is patentable. We therefore respectfully request that these claims be allowed.

Claim 23

Claim 23 is directed to a multi-line utility power transmission system comprising a first power transmission line having a first impedance characteristic; a second power transmission line including a superconductor, in parallel with the first power transmission line, and having a second impedance characteristic less than the first impedance characteristic; and a power flow controller, coupled to the second power transmission line, for selectively regulating during normal operating conditions of the power transmission system by a variable amount at least one of the magnitude and direction of the power flowing through the second power transmission line. The power flow controller is configured to selectively regulate the power flowing through the second power transmission line to provide at least one of load balancing between the first power transmission line and the second power transmission line and flow optimization between the first power transmission line and the second power transmission line. The power flow controller is further configured to restrict a total amount of current allowed to pass

through the second power transmission line while maintaining a superconductive state of the second power transmission line.

As discussed above, we submit that Morita's current-limiting element cannot be considered a power flow controller that "selectively regulat[es] during normal operating conditions ... by a variable amount at least one of the magnitude and direction of the power," as recited in independent claim 23. Furthermore, as discussed above, we submit that even assuming Morita's current-limiting element was a power flow controller, it still would not have been obvious to one of ordinary skill in the art to couple Morita's current-limiting element with Sinha's electric system to arrive at the multi-line utility power transmission system of claim 23.

For at least the above reasons, we submit that independent claim 23 is patentable over Sinha and Morita. We therefore respectfully request that claim 23 be allowed.

Conclusion

Appellant respectfully submits that, for at least the reasons presented above, claims 1, 3-11, and 13-15, and 19-23 are patentable over the prior art. Accordingly, Appellant respectfully requests allowance of these claims.

The appeal brief fee in the amount of $510 is being paid concurrently herewith on the Electronic Filing System (EFS) by way of Deposit Account authorization. Please apply all charges or credits to Deposit Account No. 50-4189, referencing Attorney Docket No. 30020-189001.

Respectfully submitted,

Date: November 3, 2008

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(8) Claims Appendix

1. (Previously Presented) A multi-line utility power transmission system comprising:

a first power transmission line having a first impedance characteristic;

a second power transmission line including a superconductor, in parallel with the first power transmission line, and having a second impedance characteristic less than the first impedance characteristic; and

a power flow controller, coupled to the second power transmission line, for selectively regulating during normal operating conditions of the power transmission system by a variable amount at least one of the magnitude and direction of the power flowing through the second power transmission line;

wherein the power flow controller is configured to selectively regulate the power flowing through the second power transmission line to provide at least one of load balancing between the first power transmission line and the second power transmission line and flow optimization between the first power transmission line and the second power transmission line;

wherein the power flow controller is configured to provide incremental flow change of current.

2. (Cancelled)

3. (Previously Presented) The multi-line power transmission system of claim 1 wherein the superconductor is a cold-dielectric high temperature superconductor.

4. (Original) The multi-line power transmission system of claim 3 wherein the high temperature superconductor is chosen from the group consisting of: thallium-barium-calcium-copper-oxide; bismuth-strontium-calcium-copper-oxide; mercury-barium-calcium-copper-oxide; and yttrium-barium-copper-oxide.

5. (Original) The multi-line power transmission system of claim 3 further comprising a refrigeration system for cooling the high temperature superconductor at a temperature sufficiently low to exhibit superconducting characteristics.

6. (Original) The multi-line power transmission system of claim 1 wherein the first power transmission line is a cross-linked polyethylene power transmission line.

7. (Previously Presented) The multi-line power transmission system of claim 1 wherein the power flow controller is a reactor.

8. (Original) The multi-line power transmission system of claim 1 wherein the power flow controller is a bi-directional power flow controller that regulates the direction of the power transferred through the second power transmission line.

9. (Original) The multi-line power transmission system of claim 8 wherein the bi-directional power flow controller is a phase angle regulator.

10. (Previously Presented) A method comprising:

connecting a first power transmission line having a first impedance characteristic in parallel with a second power transmission line including a superconductor and having a second impedance characteristic less than the first impedance characteristic;

supplying power to the first power transmission line and the second power transmission line;

determining a level of power flow for the second power transmission line; and

selectively regulating during normal operating conditions of the power transmission system by a variable amount the power transferred through the second power transmission line to provide at least one of load balancing between the first power

transmission line and the second power transmission line and flow optimization between the first power transmission line and the second power transmission line;

wherein selectively regulating the amount of power transferred through the second power transmission line includes changing the flow of current incrementally.

11. (Original) The method of claim 10 further comprising regulating the direction of the power transferred through the second power transmission line.

12. (Cancelled)

13. (Previously Presented) The method of claim 10 wherein the superconducting power transmission line is a cold dielectric high temperature superconductor.

14. (Original) The method of claim 10 further comprising maintaining the high temperature superconductor at an operating temperature sufficiently low to enable the high temperature superconductor to exhibit superconducting characteristics.

15. (Original) The method of claim 10 further comprising forming the first power transmission line with a cross-linked polyethylene.

16. (Cancelled)

17. (Cancelled)

18. (Cancelled)

19. (Previously Presented) The multi-line utility power transmission system of claim 1, wherein the power flow controller comprises a plurality of reactors, each of

the reactors being configured to limit an amount of current that can flow on the second power transmission line.

20. (Previously Presented) The multi-line utility power transmission system of claim 19, wherein the power flow controller is configured such that a desired impedance characteristic for the second power transmission line can be achieved by activating or deactivating one or more of the plurality of reactors.

21. (Previously Presented) The multi-line utility power transmission system of claim 1, wherein the power flow controller is configured to provide a desired impedance characteristic to provide load balancing between the first power transmission line and the second power transmission line.

22. (Previously Presented) The multi-line utility power transmission system of claim 1, wherein the power flow controller is further configured to control a phase angle through the second power transmission line.

23. (Previously Presented) A multi-line utility power transmission system comprising:

a first power transmission line having a first impedance characteristic;

a second power transmission line including a superconductor, in parallel with the first power transmission line, and having a second impedance characteristic less than the first impedance characteristic; and

a power flow controller, coupled to the second power transmission line, for selectively regulating during normal operating conditions of the power transmission system by a variable amount at least one of the magnitude and direction of the power flowing through the second power transmission line;

wherein the power flow controller is configured to selectively regulate the power flowing through the second power transmission line to provide at least one of load

balancing between the first power transmission line and the second power transmission line and flow optimization between the first power transmission line and the second power transmission line;

wherein the power flow controller is further configured to restrict a total amount of current allowed to pass through the second power transmission line while maintaining a superconductive state of the second power transmission line.

(9) Evidence Appendix

None.

(10) Related Proceedings Appendix

None.